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Neurological and Behavioral Effects of Trance States

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Abstract: The neurological and behavioral effects of trance states are investigated. An explanation of trance states and other altered states of consciousness are discussed including methods of induction. The limited understanding of the true definitions of each of the states is discussed as well. Neurological effects of trance states are consistent with increased right brain activity and the implications of increasing the access to right brain structures are discussed. A review of neuroimaging of trance states is presented through several studies as well as the behavioral modifying uses of trance states.

"Meditation is the dissolution of thoughts in Eternal awareness or Pure consciousness without objectification, knowing without thinking, merging finitude in infinity." Voltaire

Introduction

From the earliest mystics, trance states have been part of the human experience. We see in all religions some form of trance whether it is called prayer or meditation. However, the understanding of different trance states is as diverse as the people who use them. It is a cross cultural phenomenon. It has been used as a parlor trick. It is a means to anesthetize without medication. It is a path to relaxation. It is a healing tool. It is a Vegas side show. It is practice to longevity. It is a fad. It is a way of life. It is a vehicle for the Devil. It is a means to create a daily balance in a crazy world. The intention of this paper is to offer an understanding of trance states and how they affect the human experience, neurologically and behaviorally.

Altered states of consciousness

Trance states are considered to fall into a broader category called altered states of consciousness. This classification also

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contains alcohol intoxication, religious ecstasy, drug trips and hypnosis. Altered states have many common attributes. First, people who experience an altered state all report a form of "otherness".[1] This concept comes from the idea that while in an altered state the individual reports that they felt that they were either transported to another place or felt not themselves. Another commonality in altered states is that they are intentionally induced. Whether you are dropping acid or sitting in the lotus position with your hands positioned in the proper mudras, you are intentionally inducing an altered state. This similarity is also present when the altered state is induced by someone else in the case of a drug administered by a doctor or being hypnotized. Another common attribute is that altered states are pleasurable. The data suggests that even "bad trips" are still considered pleasurable.[2]

With the criteria for altered states set forth, our first inclination is that there has to be a difference between a drug induced euphoria and a meditative Zen state.[3] As evidenced in the table below, many of our daily experiences are considered altered states.

Table 1. Domains Associated With Alterations of Consciousness Classified by Their Origin or Method of Induction[4]

Origin	Alteration
Spontaneously occurring	States of drowsiness Daydreaming Hypnagogic states Sleep and dreaming Near-death experiences
Physically and physiologically induced	Extreme environmental conditions (pressure, temperature) Starvation and diet Sexual activity and orgasm Respiratory maneuvers
Psychologically induced	Sensory deprivation, homogenization, and overload Rhythm-induced trance (drumming and dancing) Relaxation Meditation Hypnosis Biofeedback
Disease induced	Psychotic disorders Coma and vegetative state Epilepsy
Pharmacologically induced	

Trance states

Merriam Webster[5] define trance states as "stupor, daze; a sleeplike state (as of deep hypnosis) usually characterized by partly suspended animation with diminished or absent sensory and motor activity; a state of profound abstraction or absorption". The concepts of abstraction and absorption will be discussed later. People have confused sleep with trance and the research shows that trance is somewhere between awake and asleep. Sleep is considered a normal state along with waking and deep sleep.[6]

As we mentioned earlier regarding altered states of consciousness, there are many varieties of trance states. There are also many ways to be induced into those states. The manner of induction not only ushers in the altered state of consciousness but is also a means to shift the individual's psychophysiology to enter into this state.[7] The means of induction are as follows:

- Auditory Driving: this means of induction requires an auditory stimulus that is rhythmic and repetitive which disrupt the asynchronous patterns that are normally found in the brain which is called driving because it drives a new neurological pattern. An example of this is repeating a mantra (a short prayer) as in chanting.[8]
- Fasting: this means of induction creates a hypoglycemic state which makes the brain vulnerable to driving a neurological pattern. Denying one's body water and fasting directly affect the adrenal and pituitary glands which directly affect the hippocampal septal systems and hypothalamus which make the person susceptible to altered states and suggestions.[9]
- Sensory deprivation and social isolation: This means of induction is seen in the use of samadhi tanks which limit the stimulus an individual experiences by having them enclosed in a tank with no light and suspended in warm water which limits any stresses put upon the body. This extreme sense of relaxation allows a parasympathetic dominant state and elevates the cortical synchronization thus creating a rhythmic pattern. This means of induction also increases the chances of hallucinations and a decrease in left hemisphere activity.[10]

- Meditation: Not only is meditation a trance state it is also an induction that will be discussed later. Different types of meditations require different devices to create the meditative state. The means of induction all seem to increase alpha and theta waves in the frontal and central regions of the brain.[11]
- Sleep and Dream states: Sleep is a means to induce a parasympathetic dominance. The hippocampal septal system exhibits the slow waves that are also found in other forms of trance.[12]
- Sexual Restrictions: Restricting or prolonging an orgasm reduces the testosterone in the system which induces a parasympathetic dominance which comes from the relief or exhaustion after sex. Some restrict the sex to induce the state without the collapse while others use practices such as tantra to prolong the orgasm which drives the trance state.[13]
- Extensive motor behavior: The exertion of the body like in dance (trance dance) depletes the body of fluids and oxygen, which coupled with repetitive movements induces a hypoglycemic state which activates the same systems as fasting.[14]
- Drugs and alcohol: These means of induction create slow waves in the brain albeit each in a different region of the brain.[15]

All of the induction drivers seem to create a parasympathetic dominance and create a slowing down and rhythmic brain wave pattern even though the means by which this was instigated is different.

Hypnosis

Unfortunately, the reputation of hypnosis is muddled with misinformation and cliché. The reality is that hypnosis is a well-established tool in therapy used by psychological forefathers such as Erickson and Freud. The state of hypnosis is no different than deep relaxation. In fact, behaviors within the hypnotic state and waking are almost indistinguishable except the deep relaxation. Hypnotic states are used instead of anesthetic and as an analgesic. Hypnosis has been known to aid in recalling

memories that were once thought lost and to even cause partial paralysis.[16] Hypnosis has gone through so many ups and downs in acceptance that it is hard to gauge where the acceptance is. In the 1950s, hypnosis was taught in medical schools in Great Britain not as a parlor trick but as a treatment tool for doctors[17], and is taught today in many American medical and dental schools.

The induction process to hypnosis is that of auditory drivers which suggest in a soothing tone to relax and imagine, which elicits the slowing and synchronizing of the wave patterns. Many hypnotherapists use music to assist in the induction process. The music is usually repetitive and pleasant (not atonal). The reality to all of the induction drivers, with the exception of outside agents that are introduced without the individual's consent like drugs, is that an individual must choose to be induced. This is one of the reasons that hypnotists assert that all hypnosis is self-hypnosis.[18]

There are certain aspects of the state of hypnosis that are not found in other trance states. Hypnotic state has the following characteristics[19]:

- Amnesia - The subject, whether through choice or suggestion, may have no recollection of the hypnotic state.
- Hypermnesia - The subject can recall details of occurrence that are not readily available in the waking state. This is one reason that this tool is used with great success by psychotherapists.
- Age Regression - Subjects are able to slip back into an earlier part of their life without need for recollection but instead a reliving of the experience.
- Dreams - Subjects are able to access a dream state and are still suggestible within the dream. This is also useful within the therapy session as a means to delve deeper into repressed memories.
- Analgesia - A pain reliever.
- Post-hypnotic Experience - The post hypnotic suggestion is used to reinforce the learning within a psychotherapy session. This is especially useful in behavior modification.

One of the issues that is often brought up is the idea of hypnotizability. Tests have been created to assess a subject's susceptibility. The tests range from paper and pencil tests to asking a subject to roll their eyes all the way back, a pin prick test which asks the subject to withstand pain, telling a subject that they lost their sense of smell and making them smell something noxious to watch their reaction. One of the common tests is to ask the subject about their fantasy life and ask them to imagine something. The richness of their fantasy life seems to lend itself to susceptibility. There apparently seems to be an inheritability to susceptibility as evidenced by identical twins research. There does seem to be agreement that there are levels to the degree of susceptibility but no indications that someone cannot be hypnotized as long as they are willing.[20]

Meditation

Meditation is a more fluid practice than the other altered states. Some consider the practice of meditation a form of prayer. As stated earlier, meditation is an induction process but also an altered state of consciousness. Meditation is not easily defined due to the multitude of methods to meditate. Some of the aspects that are agreed upon are that it is ■ technique that requires some form of relaxation and is self-induced. The techniques vary within different systems and the goals to meditation vary as well. One of the aspects of meditation that is generally agreed upon is that it brings about a mental calmness.[21]

The different forms of meditation are vast and usually associated with some form of religious or spiritual practice. The most popular forms of meditation are:

- Transcendental Meditation which requires special training and uses auditory drivers in the form of a mantra of one word or sound as an induction.[22]
- Zen Meditation is based on posture and breathing. Done in the lotus position, the individual focuses on their breathing and posture to eliminate distractions. If the person is distracted, they are to immediately return to focusing on their breathing and posture.[23]
- Mindfulness Meditation is like Zen, as it requires breathing techniques and posture, but the individual is required to stay present. If distracting thoughts come

into their mind they are to observe the thoughts but not react.[24]

- Walking meditation is focused on staying present in the moment and on the movement and breath.[25]
- Trataka Meditation is different in that the individual focuses on an object. This form of meditation is cross culturally popular in that it is used in Christian faiths in focusing on the cross or a saint. The individual focuses on an object and then closes their eyes and is still required to see the object through their third eye. The individual can open their eyes several times during a session.[26]
- Japa Meditation is the use of beads and chanting a mantra while counting them off on beads. The beads usually number 108 or a multiple of that. The individual is to focus on the mantra repetition and if distracting thoughts enter the mind they are to refocus on the mantra. Interestingly, this is practiced by Hindus and Buddhists but it strongly resembles the rosary used in the recitation of the Hail Mary by Catholics.[27]

Much research has been done on meditation; however, much of it seems to be fairly unscientific. What has been concluded is that people meditate for two reasons. First, a person wishes to address a psycho-emotional issue and use meditation to control their reaction to the situation. The second reason people report that they meditate is for spiritual gains, obtaining wisdom, becoming centered and expanding their understanding of life in general.[28] And yet, with all the different forms of meditation and different reasons given for meditating, meditation seems to work better than overall relaxation when compared for their desired effects.[29]

Physiological indications and effects of trance states

As indicated earlier, there are several altered states of consciousness (ASC). Some are spontaneously induced such as drowsiness and daydreaming, whereas some are intentionally entered whether through a specific technique or psychoactive agents. All of these share certain similarities regardless of how they were induced or which brain regions were activated to

achieve the ACS. Researchers have found that individuals who achieve an ASC all report changes within themselves specifically in their perception of time and their bodies in their environment, and their own understanding of them. These individuals report an alteration of their emotions, sense of significance, and a general sense of rejuvenation and ineffability. These individuals present with hypersuggestibility, not due solely to the ACS but because of how they have reacted to the ACS. Lex[30] suggests that trance states activate a trophotropic (relaxation) pattern in the brain, which presents as a parasympathetic discharge which elicits a state of relaxation of the musculo-skeletal system and subsequently synchronizes the cortical rhythms which indicates right hemisphere dominance. The significance of this is evidenced in the following table created by Dr. Wilson[31]:

Table 2. The Sympathetic and Parasympathetic Nervous Systems

	Sympathetic System	***Parasympathetic System***
Function	To defend the body against attack	Healing, regeneration and nourishing the body
Overall Effect	Catabolic (breaks down the body)	Anabolic (builds up the body)
Organs and Glands It Activates	The brain, muscles, the insulin pancreas, and the thyroid and adrenal glands	The liver, kidneys, enzyme pancreas, spleen, stomach, small intestines and colon
Hormones and Substances It Increases	Insulin, cortisol and the thyroid hormones	Parathyroid hormone, pancreatic enzymes, bile and other digestive enzymes
Body Functions It Activates	Raises blood pressure and blood sugar, and increases heat production	Activates digestion, elimination and the immune system
Psychological Qualities	Fear, guilt, sadness, anger, willfulness, and aggressiveness.	Calmness, contentment and relaxation
Factors That Activate This System	Stress, fears, anger, worry, excessive thinking and too much exercise	Rest, sleep, meditation, relaxation therapies and feelings of being loved

The table reflects how becoming right brain dominant within the trance state can bring a state of calm and allows for a feeling of well-being to the individual.

The specific neurogenesis of trance states is a neurochemical pathway which works directly with "biogenic amine-temporal lobe interaction".[32] EEGs have shown that high frequency slow waves are initiated in the hippocampal-septal region of the brain

which enforces a synchronized slow wave pattern on the frontal lobe.[33] The hippocampal-septal region is located in the area of the brain that is considered the older part of the brain structure or the primitive brain which includes the limbic system. The hippocampal-septal region is highly innervated and forms a connection from the limbic system to the frontal cortex. Thus, it is responsible for connecting the area that houses the basic urges and drives like sex, hunger and thirst as well as the seat of emotions in the amygdala to the forefront of our thought processing in the frontal cortex. The limbic system also houses the hypothalamus which governs the pituitary gland, which is responsible for many neurotransmitters, some of which control the reticular activating system which controls the wake and sleep cycles, and other transmitters that create hallucinogenic and analgesic effects.[34]

The hypothalamus also governs the sympathetic and parasympathetic systems (Table 2). The sympathetic nervous system is responsible for activating and stimulating the adrenal medulla which secretes hormones which result in desynchronizing brain waves, widespread cortical excitation, and the readying of the musculo-skeletal system through the spread of tension and stress. This system is responsible for arousal, anxiety and excitability.[35] The parasympathetic nervous system resynchronizes brain waves. Normally, the parasympathetic system is activated by sleep; however, trance states also activate the system and create a right brain dominance that squelches the usual asynchronous activity in the brain.[36]

Neuroimaging of trance states

A study that researched the electrophysiological changes during hypnosis began with the premise that hypnosis is more than one thing. They began with the idea that hypnosis is an altered state of consciousness which increases imagination, focused awareness, attentional control, altered perception, relaxation as well as suggestibility, and that all of these things indicate that hypnosis is a distinct change to the brain. In this study of one highly susceptible male individual, the results showed that there were significant changes in his brain activity during different sections of the hypnosis script which included arm levitation and instructions to go even deeper into trance. The

researchers noted a significant change in the brain waves the subject emitted following the instruction to deepen the trance. They noted also that during the arm lift the subject felt his arm lift by itself as if by an external force. The other interesting fact was that the subject still appeared to be in an altered state after the session, as his brain waves continued to show signs of relaxation.[37]

Another study reviewed the research on positron emission tomography (PET), electroencephalography (EEG), and functional magnetic resonance imaging (fMRI) which showed a distinction between hypnosis and meditation. They analyzed the shared substrates between these two forms of trance states. They compared hypnosis to mindfulness meditation which is used by Tibetan Buddhists. They found that meditation produced high amplitudes in alpha frequency bands in the frontal regions whereas the hypnosis subjects showed the elevations in the central and temporal locations. They noted that hypnosis is a technique that heightens a person's suggestibility and is dependent on the hypnotist instructing the subject, thus the temporal activation where the subject would process words and directions. Meditation is focused on the self and quieting thoughts, which would indicate more activity in the region of the brain that controls active thought.[38]

With all the research that has been done, researchers cannot pinpoint exactly what is happening in the brain during hypnosis. One study proposed that the frontal lobe would be affected during "pure" hypnosis as opposed to any other time. They explained that "pure" hypnosis is performing an induction and not providing any further suggestion such as "go deeper" or "relax". The subjects were provided several sessions of "pure" hypnosis over a period of time while simultaneously receiving an EEG. They were also tested with an EEG at other times over the course of years to see if there was different activity present in the frontal lobe. They found that subjects showed a significant reorganization in the prefrontal and right occipital EEG channels and these subjects consistently showed right brain dominance. Also, the EEGs of the hypnotized subjects showed a spectral pattern which did not diminish after the hypnosis was concluded. They also noted a pattern of heightened attention and increased alertness. This was not noted in the non-hypnotized subjects. The

conclusion the researchers arrived at was that hypnosis changed the neuronal activity in the brain.[39]

Also, the neurological imaging of subjects while hypnotized is very similar to those of patients suffering traumatic events and their recollections of said events. Researchers have found that similar areas of the brain are activated during traumatic recall. Specifically they have found using fMRIs and PET scans that the hippocampus, amygdala, medial pre-frontal cortex, anterior cingulate cortex and thalamus are implicated during emotional recall and hypnosis. PET scans that focused on traumatic recall showed activations of the limbic and paralimbic systems in the right hemisphere: thus the activation of right brain dominance as seen in trance states.[40]

Neuroscience of behavior modification within trance states

In the ever growing area of cognitive neuroscience, researchers are spending time investigating the power of suggestion and suggestibility within individuals. The practical value of understanding this system is the difference between a person suffering from anxiety or addiction, and having the ability to provide a simple suggestion to ameliorate the disorder and dysfunction. Even though many studies are showing that suggestibility is not limited to hypnosis, most researchers still believe in the use of hypnosis to study this phenomenon. Even with the introduction of neuroimaging into the field, many researchers feel the need to employ these techniques to neurologically verify a behavior as if this makes the modification more real.[41]

The behavioral aspects of trance states are less defined because they are subjective. However, one aspect that can be measured empirically is the rate of absorption within a trance state. Absorption refers to the ability to focus and attend to stimuli and become immersed in it. This trait is seen frequently in individuals who practice trance states such as meditation and hypnosis. Absorption has been shown to be related to an individual's ability to reduce their anxiety.[42] Obviously this relationship does not indicate causality; however, the presence of absorption, which is ever present in meditation and trance states, seems to have an influence on one's ability to self-regulate.

Altered states of consciousness are being employed in different areas of psychology as treatment. One area that hypnosis has been used effectively in as a behavior modification tool is smoking cessation. The study in question looked not just at the efficacy of using hypnosis to modify the smoking behavior but also how it was employed. It was noted that the therapist's comfort with the use of hypnosis was vital to the success of the treatment. In other words, the suggestion started from the onset of the therapy and not only at the moment of the smoking cessation suggestion.[43]

Trance states have also been employed in pain reduction. Anecdotally, the writer used hypnosis during the labor and birth of her third child. In relation to the other labors, the hypno-birthing was considerably less stressful and even resulted in a more enjoyable experience. The contractions were still as severe but the interpretation of the pain was different than previous experiences. Also, the reaction to having the child be born wrapped in the cord several times and with a blue appearance would normally have been met with anxiety and panic, whereas in the hypno-birth example, the incident was met with calmness.

The use of hypnosis or hypnogogic states in pain reduction is quite prolific. This is finding great success when working with children. They have found with neuroimaging that the midcingulate cortex is activated when the subject is engaged in hypnotic analgesia. Simple suggestions that the affected area of the body is numb or has had the nerves removed seem to dissipate the perception of pain. Children's susceptibility to pain is higher than adults' and thus hypnosis has a better effect as an analgesic. Even when compared to cognitive behavioral therapy which included relaxation techniques, the children seemed less distressed from pain when employing hypnosis.[44]

Hypnosis has also proven successful in reducing the adverse effects of menopause. Oncologists are currently employing hypnosis to help breast cancer survivors with hot flashes. Women who survive breast cancer report 65% more hot flashes and night sweats due to the medication that they are given to prevent further cancers. The night sweats and hot flashes are so extreme that women are known to stop taking the medication and instead risk the reoccurrence of the cancer. These women were introduced to hypnosis and given "coolness" imagery. The

women who received this treatment reported a reduction of hot flashes, anxiety, and depression subsequent to the training in contrast to the women who received no treatment.[45]

These results seem unbelievable when considering that science is not quite clear why it works. This idea was further tested by researchers who chose to compare mindfulness meditation with a "sham" meditation. They targeted subjects who had mood disorders and cardiovascular conditions. The researchers treated the subjects with three 20 minutes sessions of mindfulness meditation or a sham meditation and compared these two groups with a control group. They found that the subjects who received the mindfulness meditations showed a reduction of depression, fatigue, negative mood and confusion. They also noted that these individuals had a better heart rate than the other groups. In other words, an hours' worth of meditation affected not only the mood of the subjects but also their heart rate that was compromized by a cardiac condition.[46]

In another study where they compared transcendental meditation, hypnosis and acupressure with a placebo treatment for patients suffering from Type II Diabetes, the subjects were given ten sessions of 1 hour and 9 minutes duration to reduce their blood sugars. What they found was that patients who were provided the acupressure and two trance forms of treatment reduced their blood sugars more effectively than the placebo groups. The treatments were done primarily to teach the subjects to relax and also suggesting and activating their beta nerve cells which stimulate the islet cells which create insulin.[47]

Controversy

Trance states are not without controversy. Religious groups denounce the use of hypnosis while others are reminded of Las Vegas performers who make people cluck like a chicken. In the early days of researching hypnosis, researchers were attempting to prove that hypnosis was just sleep. The word hypnosis was taken from the Greek word to sleep and with a subject presenting with eyes closed and deeply relaxed, it is understandable why they would have believed this. In fact, one of the first hypnosis studies using an EEG machine showed that the subjects displayed no difference between hypnosis and sleep.[48]

Even recently, researchers were trying to determine whether hypnosis was another altered state of consciousness or the human trait of suggestibility. They noted that some people are extremely suggestible and some people show signs of suggestibility without the use of hypnosis. They tested whether a subject would be more suggestible without hypnosis than with it. They found that hypnosis did make the subjects more suggestible and that, even though people showed suggestibility without hypnosis, the group who received the suggestions scored significantly higher.[49]

Conclusion

The neurological and behavioral effects of trance states are numerous. Discovering the right brain dominance during an altered state of consciousness helps to explain the experience. With the knowledge we have of the lateralization of the brain in comparing the right to the left hemispheres, one can see that the emotional response becomes more prominent while the need to analyze which is directed by the left hemisphere is less important. Also the information regarding the parasympathetic system discharging explains many of the benefits that are found through routine practice of trance states such as meditation. As a practitioner of hypnotherapy, this resolves many of the questions this writer has had regarding the actual mechanisms of trance. The research is clear that altered states of consciousness are an intentional activity that is entered into. The benefits are clear whether it is to modify a behavior through suggestion, reduce a heart rate, blood sugar or even as an analgesic. What is even clearer is that further research must be conducted to understand the extent to which the right brain dominance can protect individuals from debilitating conditions such as anxiety. The evidence is clear that trance states are beneficial to the human condition.

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